Test Procedure for

AGGREGATE QUALITY MONITORING PROGRAM

TxDOT Designation: Tex-499-A

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1. SCOPE

1.1 The Aggregate Quality Monitoring Program (AQMP) provides the requirements and procedures for the Construction Division, Materials and Pavements Section (CST/M&P) to accept aggregate products that have demonstrated continuing quality and uniformity.

1.2 The AQMP allows districts to use aggregates from rated sources without project specific testing by CST/M&P for the tests listed in the catalog when the published ratings meet the project specifications.

1.3 The AQMP provides continuous quality assurance of aggregate products. The program includes:

1.3.1 Monitoring of the mineralogy/durability quality of aggregate products representing normal production at a single source;

1.3.2 Statistical evaluation of recent aggregate quality test histories;

1.3.3 Expediency in aggregate quality acceptance; and

1.3.4 Optimized resource utilization by reducing aggregate acceptance on a test-prior-to-use basis.

1.4 Aggregate suppliers participate in the AQMP based on test history of aggregate products used on Department projects. The Department created the AQMP to improve efficiency of Department operations. Participation is not at the option of the aggregate supplier.

1.5 Aggregate suppliers may supply aggregate to a project that requires a higher quality classification by building separate stockpiles and meeting the higher quality specification requirements for the project based on Department testing of project samples.

1.6 The values given in parentheses (if provided) are not standard and may not be exact mathematical conversions. Use each system of units separately. Combining values from the two systems may result in nonconformance with the standard.

2. DEFINITIONS

2.1 *Aggregate*—granular material of mineral composition such as sand, gravel, shell, slag, crushed stone or lightweight. Use aggregate with a cementing medium to form mortars, hydraulic cement concrete, asphalt concrete and treated base courses, or alone in granular base courses or surface treatments.

2.2 *Bituminous Rated Source Quality Catalog (BRSQC)*—a catalog published biannually by CST/M&P to update the rated source statistical values for the quality tests covered by the AQMP for bituminous aggregates.

2.3 *Concrete Rated Source Quality Catalog (CRSQC)*—a catalog published biannually by CST/M&P to update the rated source statistical values for the quality tests covered by the AQMP for hydraulic cement concrete aggregates.

2.4 *Informational Sample*—a sample taken and tested to establish an initial indication of quality. An informational sample cannot substitute for a project or QM sample.

2.5 *Job Control Tests*—tests routinely performed on a project basis to ensure specification compliance.

2.6 *Lightweight Aggregate*—expanded shale, clay, or slate, produced by the rotary kiln method.

2.7 *Outlier*—a single test result that:

- represents improved quality;
- deviates 25% or more from the average of the other four test results; and
- when used in the statistical calculation of the rating, has a negative effect on the rating.

2.8 *Producer*—any business or individual that manufactures a product and seeks to supply that product to the Department or contractors of the Department.

2.9 *Product*—a material, produced from a single source, which meets a Department specification.

2.10 *Project Sample*—a sample taken from aggregate designated for a specific Department project. The aggregate may be in a stockpile located at the quarry, plant, rail yard, roadway, truck, or railcar.

2.11 *Quality Assurance (QA)*—Sampling, testing, inspection, and other activities conducted by the Department to monitor the quality, uniformity, and acceptability of aggregates.

2.12 *Quality Control (QC)*—Sampling, testing, and other process control activities conducted by the producer to monitor and adjust production to maintain the quality of an aggregate product.

2.13 *Quality Control Plan (QCP)*—an overall system developed and used by a producer or supplier that ensures that a product will meet the specified quality standards.

2.14 *Quality Monitoring Sample (QM)*—a non-project specific sample tested by CSTM&P for aggregate quality properties specified in Section 3.

2.15 *Rated Source*—a source with one or more aggregate product(s) meeting the AQMP eligibility and acceptance criteria, and rated statistically for quality by CST/M&P.

2.16 *Selective Quarrying*—the practice of processing certain strata or layers of material for a designated aggregate product.

2.17 *Source/Pit*—a geographical location of naturally occurring material, mined or quarried from the original in-situ deposit.

3. RESPONSIBILITIES

3.1 *CST/M&P:*

3.1.1 The Geotechnical, Soils, and Aggregates branch of CST/M&P is responsible for requesting QM samples, testing for properties listed in the rated source quality catalogs, evaluating the validity of sampling and testing, reporting results, maintaining the rated source quality catalogs, and notifying the affected producer of any status change of AQMP sources.

3.1.2 Tests performed on coarse aggregate for hydraulic cement concrete are:

- Los Angeles abrasion (Tex-410-A),
- Five-cycle magnesium sulfate soundness (Tex-411-A), and
- Micro-deval (Tex-461-A).

3.1.3 Tests performed on fine aggregate for hydraulic cement concrete are:

- Acid insoluble residue (Tex-612-J).

3.1.4 Tests performed on coarse aggregate for asphalt concrete or surface treatment are:

- Los Angeles abrasion (Tex-410-A),
- Five-cycle magnesium sulfate soundness (Tex-411-A),
- Acid insoluble residue (Tex-612-J), and
- Micro-deval abrasion (Tex-461-A).

3.1.5 Tests performed on aggregate for micro-surfacing are:

- Five-cycle magnesium sulfate soundness (Tex-411-A) and
- Acid insoluble residue (Tex-612-J).

3.1.6 Tests performed on lightweight aggregate for asphalt concrete or surface treatment are:

- Los Angeles abrasion (Tex-410-A),
- Five-cycle magnesium sulfate soundness (Tex-411-A),
- Acid insoluble residue (Tex-612-J),
- Micro-deval abrasion (Tex-461-A),
- Freeze thaw loss (Tex-432-A), and
- Pressure slake loss (Tex-431-A).

3.1.7 CST/M&P will evaluate a source's quality control test results, procedures, equipment, laboratory facility, and technician certifications to provide a quality assessment.

3.2 *Districts:*

3.2.1 The District within which the AQMP source is located is responsible for:

- Taking QM samples from active sources;
- Delivering samples to CSTM&P with accurate and detailed sample information;
- Signing in at the producer's office and/or scale house before entering the quarry;
- Splitting QM samples with the producer's designated quality control personnel (Failure to offer a split sample to the producer may cause the sample to be determined invalid);
- Verifying the plant and pit locations; and
- Requesting a CST/M&P investigation of the source/pit if the district suspects a change in aggregate production and/or quality.

3.2.2 The user District is responsible for:

- Job control testing;
- Final acceptance of the aggregate product,
- Submitting a QM sample from the project when material from an AQMP source has questionable quality;
- Delivering samples to CSTM&P with accurate and detailed sample information;
- Signing in at the producer's office and/or scale house before entering the quarry;
- Splitting QM samples with the producer's designated quality control personnel (Failure to offer a split sample to the producer may cause the sample to be determined invalid); and
- Requesting a CST/M&P investigation of the source/pit if the district suspects a change in aggregate production and/or quality.

3.3 *Producers:*

3.3.1 The producer is responsible for:

- Notifying CST/M&P and the district if they want to split samples when the Department takes a sample;
- Notifying CST/M&P of changes in ownership, pit and/or plant location, and designated quality control personnel at the plant;
- Maintaining current contact information at CSTM&P, including but not limited to email address, phone number, mailing address, and name of contact person;
- Submitting a map detailing the pit location and directions to the pit;
- Submitting global positioning coordinates of the pit;
- Submitting a mining plan to CST/M&P annually (CSTM&P may request a mining plan more frequently);
- Maintaining at the pit/plant a map delineating the boundaries of the source; and
- Maintaining legible stockpile identification in all stockpiles, at all times (stockpile identification will include whether the material is for Department or non-Department use).

3.3.2 Failure to fulfill requirements outlined in this section will result in removal of the source from the AQMP.

4. ELIGIBILITY/ACCEPTANCE CRITERIA

4.1 Source Eligibility Criteria:

4.1.1 AQMP only applies to aggregates produced from a single source or pit.

4.1.2 A source may expand to include its adjacent properties if the materials produced are the same, as determined and approved by CST/M&P.

4.1.3 AQMP will include naturally blended aggregates only if the component materials originate from a single source or pit.

4.1.4 The Department can perform inspection of the quarry at any time.

4.2 For acceptance in the AQMP, the individual aggregate product must meet the following:

4.2.1 Have a test history of at least five Department project samples (of the same geologic type and proposed product use) within the past two years;

4.2.2 The sampling dates of the above five project samples are at least one month apart and each sample is from material produced since the last sample;

4.2.3 The five most recent sample test results satisfy all the standard specification quality requirements for the aggregate product;

4.2.4 The statistical ratings of the five-sample test history meet all the applicable specification quality requirements for an aggregate product.

4.3 Upon acceptance of an aggregate source or product on the AQMP, CST/M&P will request and test a QM sample.

4.4 CST/M&P will calculate the first AQMP rating for the product from statistical analysis of the first QM sample and the four most recent project samples.

5. STATISTICAL EVALUATION AND ASSIGNMENT OF RATINGS

5.1 CST/M&P performs a statistical evaluation of the source's test history using results from the five most recent samples. The samples must meet the following criteria:

- Be a minimum of 30 calendar days apart;
- Be from material produced since the last sample;
- Be used in the production of the specified product;
- Be a QM or project sample;
- Be tested using normalized gradations, when required by the test procedure.

5.2 When sampling of a source occurs multiple times within a 30-day period, CST/M&P will consider many factors to determine which sample to include in the statistical rating calculation. Factors considered will include (but not be limited to) sample date, purpose of the sample, stockpile grade, sampling location, variation in test history, average of all samples tested within the same 30-day period, results of other tests performed on the same sample, and whether the sample contained all sizes necessary to perform the tests.

5.3 When calculating a new rating, CST/M&P will use a combination of new results plus results used in the previous rating calculation to make a total sample population of five samples.

5.4 CST/M&P calculates AQMP ratings using the following equations:

5.4.1 For Los Angeles abrasion, soundness, pressure slake, and freeze thaw loss:

$$R = \overline{X} + P\,(MS / N)^{0.5}$$

5.4.2 For acid insoluble residue:

$$R = \overline{X} - P\,(MS / N)^{0.5}$$

Where:

R = the statistical rating, rounded to a whole number (except for pressure slake and freeze/thaw which are rounded to the nearest tenth)

$\overline{X}$ = mathematical average of the five most recent test results

P = 3.747, which is the factor used to provide a 99 percent confidence level that all test results will be equal to or better than the rated value

MS = variance of the five most recent test results

N = 5, which represents the number of test results used in the statistical calculation. The AQMP will identify the statistical values of the quality tests as:

- RSLA for rated source Los Angeles abrasion
- RSSM for rated source five-cycle magnesium sulfate soundness
- RSSN for rated source five-cycle sodium sulfate soundness
- RSAI for rated source acid insoluble residue
- RSFT for rated source freeze thaw loss
- RSPS for rated source pressure slake loss.

5.5 The statistical analysis will not use an individual test result if it meets the definition of an outlier.

5.6 The outlier will be replaced by the closest test value among the other four test results.

5.7 Example Calculations:

The five most recent acid insoluble residue test results are 84, 85, 97, 92, and 94.

$$\overline{X} = \frac{\sum X}{N} = \frac{84+85+97+92+94}{5} = \frac{452}{5} = 90$$

$$\sum(X^2) = (84)^2 + (85)^2 + (97)^2 + (92)^2 + (94)^2$$
$$= 7{,}056 + 7{,}225 + 9{,}409 + 8{,}464 + 8{,}836$$
$$= 40{,}990$$

$$(\sum X)^2 = (84+85+97+92+94)^2$$
$$= (452)^2$$
$$= 204{,}304$$

$$MS = \frac{\sum(X^2) - \frac{1}{N}(\sum X)^2}{N-1} = \frac{40{,}990 - 0.2(204{,}304)}{4}$$
$$= \frac{40{,}990 - 40{,}860.8}{4} = \frac{129.2}{4} = 32.3$$

$$RSAI = \overline{X} - 3.747(MS/5)^{0.5} = 90 - 3.747(32.3/5)^{0.5}$$
$$= 90 - 3.747(2.542) = 90 - 9.525$$
$$= 80.476 = \underline{\underline{81}}$$

5.8 CST/M&P assigns a surface aggregate classification (SAC) to all bituminous coarse aggregate sources based on rated statistical values, according to the criteria shown in Table 1. SAC values may be determined for an individual project sample in order to try to meet a project specification requirement that is higher than the rated SAC value.

Table 1—Classification Criteria

Property	Test Method	SAC A	SAC B	SAC C
Acid insoluble residue, % min	Tex-612-J	55	----	----
5-cycle Mg, % max	Tex-411-A	25	30	35
Crushed Faces, 2 or more, % min	Tex-460-A	85	85	85

6. AQMP MAINTENANCE

6.1 Test results of QM and project samples replace the oldest project or QM sample test results. This maintains a moving population consisting of the five most recent samples used for the statistical evaluation. Upon request, CST/M&P will provide the producer with the five most recent QM test results used to calculate the statistical rating.

6.2 An aggregate product will remain on the AQMP as long as its statistical rating of the five most recent project and/or QM sample test results continues to remain within the standard specification limits for all aggregate quality tests.

6.3 An effective quality control program maintained by the producer can help manage the quality and uniformity of an aggregate product and minimize changes in status of a product on the AQMP.

7. SOURCE REMOVAL AND REINSTATEMENT

7.1 When any of the statistical ratings of an aggregate product on the AQMP fail to meet the specification requirement, CST/M&P will take the following actions:

7.1.1 Review all available information, including the source history, petrographic analysis of samples, relevant producer quality control results on split samples, sampling procedures, test procedures, and test equipment. Upon identification of a problem, CST/M&P will take corrective action, including a possible retest if material from the original sample is available.

7.1.2 If the review does not identify any problems, CST/M&P will remove the supplier from the AQMP on the next publishing date and notify the supplier and districts.

7.2 When an individual sample's test results for an aggregate product do not meet the specification requirements, CST/M&P will take the following actions:

7.2.1 Review all available information, including the source history, producer's mining location, petrographic analysis of samples, relevant producer quality control results on split samples, sampling procedures, test procedures, and test equipment. Upon identification of a problem, CST/M&P will take corrective action, including a possible retest if material from the original sample is available.

7.2.2 If the review does not identify any problems, CST/M&P will remove the supplier from the AQMP immediately and notify the supplier and affected districts.

7.2.3 Affected districts will evaluate the disposition of materials supplied from sources removed from the AQMP and proposed for a project according to the following:

7.2.3.1 The district will accept material already incorporated in pavements prior to the removal date without penalty.

7.2.3.2 Material incorporated in pavement after the removal date is subject to adjustment. Districts should consider contract adjustments based on representative samples of the materials delivered if they can be associated with the same delivery. Handling is at the district's discretion.

7.2.3.3 Materials not already incorporated in the work will require project specific testing to verify compliance. For project specific testing:

7.2.3.3.1 Request sampling according to Section 9.1 and submission to CST/M&P for testing. If the sample does not meet specifications, the Engineer may reject the material or accept the material with penalty. Penalties may include but not be limited to price reduction and performance warranties and will be contingent upon intended material use, degree of material failure, expected material performance life, and replacement cost.

7.2.3.3.2 When a test procedure requires normalized gradations for testing, CST/M&P, the District Engineer, and producer may agree to accept material for specific projects based on the project-specific gradation requirement in lieu of the normalized gradation. Under these conditions, the Department will sample and test material using all individual stockpiles used to make the product, but will calculate the result in accordance with the project job mix formula.

7.3 Once removed from the AQMP, the aggregate source can only supply Department projects and requisitions on a test-prior-to-use basis. The District is responsible for aggregate quality sampling at the rate stated in the 'Guide Schedule for Sampling and Testing.'

7.4 Micro-deval results are quality indicators. The producer may use micro-deval results to determine whether they want to ship aggregate before CST/M&P testing is complete, but CST/M&P will base acceptance on CST/M&P results and other aggregate requirements included in the applicable specification.

7.5 Reinstatement on the AQMP requires re-establishing a satisfactory project sample test history and meeting the AQMP acceptance criteria stated in Sections 4 and 5. Testing using normalized gradations are the only basis for reinstatement in the Rated Source Quality Catalogs.

8. PRODUCER CODE NUMBER

8.1 CST/M&P assigns a seven-digit producer code number to each source or pit on the AQMP. This number identifies all test data from that source for statistical analyses.

8.2 Changes in source ownership will not affect AQMP status unless significant production processes are changed.

8.3 The Bituminous Rated Source Quality Catalog and the Concrete Rated Source Quality Catalog list current AQMP sources and products.

9. AQMP SAMPLE RESPONSIBILITY AND FREQUENCY

9.1 An authorized representative of the Department, certified in Tex-400-A, will take samples from each AQMP source. The authorized representative will sample each aggregate product according to Tex-400-A, and split all QM samples with the producer.

9.2 Sampling frequency for individual quarries will be established by CST/M&P based on the following considerations:

- material consistency
- material quality
- production trends based on pit history
- production rate
- quantity and frequency of use on Department projects
- test results of material sampled from projects.

9.3 CST/M&P may request QM samples at any time.

9.4 District representatives may submit samples from the quarry or a project at any time.

10. UPDATING AND REPORTING OF RATED SOURCE STATISTICAL VALUES

10.1 CST/M&P publishes the statistical values for the quality tests covered by AQMP in the Bituminous Rated Source Quality Catalog and the Concrete Rated Source Quality Catalog. The catalogs are updated in June and December, as well as when a source is added or removed from the catalogs. These two catalogs are published with the Material/Producer Lists on the Department web page.

10.2 For rated sources where the statistical value changes with the issuance of a new catalog, the effective date of the catalog and the date of shipment of material are significant dates.

10.2.1 Material shipped on or after the effective date of the catalog will have the new RSQC statistical values.

10.2.2 Material shipped prior to the effective date of the catalog will have the statistical values published in the previous RSQC.

10.2.3 The Department may add new sources and reinstated AQMP sources to the catalogs any time as long as they meet the requirements of Sections 4 and 5.

10.2.4 It is the user's responsibility to verify the aggregate product meets specific specification requirements prior to use.